

Case Study - Malatech Bioaugmentation

950 m³/d Brewery UASB & activated sludge industrial WWTP

Goals of bioaugmentation:

The brewery has a fluctuating production. It results massive daily shifts in hydraulic, and cumulative COD load at the WWTP. Despite equalization, the UASB reactor did not tolerate the changes especially in cumulative COD load. The anaerobic granules fell apart from time to time, and washed from the system requiring the operator to import custom anaerobic sludge by trucks for a massive cost on a regular basis. The fluctuating performance of the UASB meant that it was unable to reduce the organic load to the desired level, and that caused adverse effects on the treatment performance of the activated sludge plant following the UASB. The operator's goal was to reduce the frequency of the anaerobic granule import, and stabilize the effluent quality of the plant.



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Title: Brewery effluent UASB + activated sludge industrial wastewater treatment plant optimization

The client factory is a worldwide beer brand with high reputation. In this manufacturing location they produce various types of beers mainly for EU market.

The treatment technology consists of an EQ tank, a UASB reactor, and an activated sludge treatment part. The activated sludge system is a circular bioreactor with anoxic and aerobic basins with a secondary clarifier in the middle.

The source of all problems in the operation of the treatment facility has always been the UASB reactor. It was designed for 1 200 m³/d average inflow (2 200 m³/d peak), with 1 833 mg/l inlet COD average (2 500 mg/l peak). The real inflow has never reached the average design cumulative COD load. When it rarely did it was due to rapid fluctuations, mainly at maintenance cleaning periods when inhibitory substances also got in the raw wastewater, and when there were beer-eliminating campaigns once or twice a year. Since the cumulative COD load, as well as the hydraulic load fluctuated in a high range the underloaded UASB could not work well. COD removal efficiency never reached the planned 75-80% value.

Since the activated sludge plant was designed assuming a well-operating UASB, it has become overloaded, and its treatment efficiency fluctuated. The factory is not located in an environmentally sensitive area though, which meant the requirements of the authority for final effluent were not strict, the factory has never been fined.

The UASB was re-seeded with custom-anaerobic granulated sludge from other UASB's 2-4 times a year. This was a costly solution since the providers' locations were hundreds of kms away from the factory. Right after reseeded each time, the granules fell apart quickly, and the UASB started to lose its sludge again before becoming empty.

The operator wanted a cost-effective solution for this never-ending procedure with the UASB, and in the meantime a more stable activated sludge performance was also targeted.

We applied Bioclean STP, and BioBooster NOC for UASB treatment, both dosed on a continuous basis by metering pumps. We continuously seeded obligate and facultative anaerobic strains for the UASB to equalize its loss, and maintain a minimum biomass which was supposed to reduce or eliminate the need of re-seeding with imported custom anaerobic granular sludge. The shock dose of Bioclean STP was 4 kg/d which was gradually reduced to 1 kg/d in a month. The maintenance dosage was varying between 0.25-0.5 kg/d depending on the measured TSS values at various levels in the UASB. When TSS dropped, the maintenance dosage of Bioclean STP was increased temporarily. BioBooster NOC has been dosed by 1.5 kg/d on a continuous basis without variation.

As for the activated sludge plant only our core technology Bioclean TM was applied to reinforce the biology, providing a higher treatment capacity for the activated sludge. We have microbes in Bioclean TM that are selected for increasing the tolerance of the activated sludge towards inhibitory or toxic loads, as well as the treated activated sludge handles fluctuating cumulative COD load better as well. Bioclean TM was applied by 5 kg/d for week 1 of treatment, 3 kg/d for week 2, 2 kg/d for week 3, and 1.5 kg/d for week 4. The maintenance dosage was set to 0.25 kg/d which has never been modified for several years.

Results for UASB:

- 1. Re-seeding has been executed 2 times in 5 years compared to 2-4 times every year before bioaugmentation.**
- 2. Average COD removal efficiency increased from 46% to 72%.**

When the plant operated with less fluctuations in cumulative COD load for a longer time, COD removal efficiency peaked between 80-90%. When high fluctuation periods came in the production, we also measured pretty low, 40-50% COD removal efficiency values either. The typical UASB anaerobic granule formation was barely experienced due to the factory's imbalanced output. Granules were small in size, usually located at the bottom part of the UASB reactor. The TSS concentrations at this level varied between 20-80 g/l for most of the time. At the higher sampling points, we have only measured disperse anaerobic sludge blanket with concentrations varying between 2-12 g/l.

Results for the activated sludge plant & final effluent:

Before bioaugmentation, the COD fluctuations in the UASB treated effluent resulted frequent shock loads for the activated sludge reactors. When the UASB was underperforming, the COD of UASB treated effluent peaked between 1 500 - 2 400 mg/l, which resulted a cumulative organic load the activated sludge reactors were unable to handle. The plant is located in a non-sensitive environment, which meant the required COD concentration for the treated final effluent was 125 mg/l set by the authority. The operator could mostly meet these criteria, even before bioaugmentation, historically the problems usually came at winter season when the UASB was nearly always underperforming, and during the shutdown in August, when the factory used a lot of chemicals to clean and sanitize the production area, as well as it conducted the elimination campaign for all the beer-residuals of the season. Bioclean TM bioaugmentation aided the activated sludge with an upgraded treatment capacity, and resistance against shock loads to keep the final effluent well below the authority limit. Besides the optimized UASB operation resulted less peaks in pre-treated COD. The combination of the 2 treatments resulted a remarkable drop in the average final effluent COD concentrations before and after the start of bioaugmentation.

